I. Project Title: Colorado's Instream Flow Protection

II. Principal Investigators:

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III. Project Summary:

The purpose of this activity is to continue obtaining instream flow protection as necessary for the endangered fishes of the Upper Colorado River Basin. It entails detailed coordination between Recovery Program agencies as well as other interested parties, water users, and environmental interests. All protection is done in accordance with Colorado water law, including instream flow rules and regulations as applicable.

IV. Study Schedule:

Although target dates were identified in the 1999 RIPRAP, the withdrawal of the 1995 instream flow filings on the Colorado and Yampa rivers resulted in changes to these dates (with the acknowledgement of Recovery Program members and Committees). Much of this project has been deferred until FY 2002 - FY 2004. In FY 2004, the instream flow issues will be revisited to determine if there is a need for instream flow filings on the Colorado and Yampa rivers.

V. Relationship to RIPRAP:

Colorado River Mainstem Activity Item Numbers: I.A.4, I.A.4.a.(3), I.A.4.b.(3), I.B.2, I.B.3.a, I.B.3.d,and I.B.4.b.(1-3).

Yampa River Activity Item Numbers: I.B.3, I.B.3.a, I.B.3.d, I.C.3.d.

VI. Accomplishment of FY 2000 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Changes to the existing instream flow filings (Case Nos. 5-95CW296 & 595CW297 on the Colorado River, and Case Nos. 6-95CW155 & 6-95CW156 on the Yampa River) occurred at the January and May 1999 CWCB meetings. As a result of concerns expressed by the Service and other Recovery Program participants, the CWCB withdrew

the base flow and recovery flow instream flow filings on the Colorado and Yampa rivers. The Colorado Division of Wildlife staff has been instructed to develop new flow recommendation methods and to make new flow recommendations when appropriate. This process is anticipated to be completed by 2002. Until the new flow recommendations are submitted and approved, the CWCB will review CDOW activities and the performance of the PBO activities and determine the need for future instream flow protection.

The State of Colorado continues to meet Recovery Goals and maintain Sufficient Progress for the Recovery Program. An outline of the Colorado Division of Wildlife's actions toward progress of new instream flow protection methods and recommendations as a result of the changes in FY 99 are provided at the end of this report.

VII. Recommendations:

It is recommended that the State of Colorado continue to participate in all activities concerning flow protection for the endangered fish in the Upper Colorado River basin.

VIII. Project Status:

Much of this project is on hold.

Since withdrawal of the recovery flow and base flow filings on the Colorado and Yampa Rivers by the Colorado Water Conservation Board, there has been much discussion and uncertainty regarding future instream flow filings for endangered fish in Colorado. Meanwhile a programmatic biological opinion has been developed for the 15-Mile Reach, and other programmatic opinions are expected, including one on the Yampa River. The Implementation Committee approved the Management Committee's recommended approach to defer instream flow filings:

a) on the Colorado River, for 5 years, contingent upon implementation of the programmatic biological opinion;

b) on the Yampa River, pending completion of a programmatic biological opinion; and

c) on the Gunnison River, pending outcome of the Aspinall biological opinion and, if needed, a programmatic biological opinion on the Gunnison River.

The State of Colorado has had considerable participation in the development of the 15-Mile Reach PBO. The CWCB continues to participate in Recovery Program activities such as Coordinated Reservoir Operations, HUP Management efforts, and the Coordinated Facilities Study that evaluate alternatives to instream flow appropriations for protection of water for endangered fish.

IX. FY 2000 Budget Status:

A.	Funds Provided:	$12,000	in-kind services, CWCB
B.	Funds Expended:	$ 1,000	
C.	Difference:	$11,000	

D. % of FY 2000 work completed, projected costs to complete:

Specific percentages are difficult to provide due to the indeterminate nature of this issue. At this time, the objective of this element should be considered "ongoing". Flow protection will be continued by the State of Colorado and other Recovery Program members in compliance with the Cooperative Agreement.

E. Recovery Program funds spent for publication charges: $0

X. Status of Data Submission: Not Applicable.

Excerpts from a June 2000 Progress Report from the Colorado Division of Wildlife are included in the Appendix.

XI. Signature: *D. Randolph Seaholm* Date: 12/8/00

APPENDIX

Colorado Division of Wildlife Instream Flow Methodology Efforts Regarding Endangered Fishes of the Upper Colorado River Basin

Title: Riverine Fish Flow Investigations (Job Progress Report)

Date: June 30, 2000

Principal Investigator: Rick Anderson

Included below are the table of contents and selected sections from the original report. The complete report can be obtained from the Colorado Division of Wildlife.

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INTRODUCTION

Habitat loss is one of the single greatest causes of declines in populations of native fishes in North America (Williams et al. 1989). The need to preserve minimum stream flows was recognized by the state of Colorado by the passage of Senate Bill 97 in 1973. Espegren (1998) states that most instream flow water right filings in Colorado have been for protecting minimum flow for cold water (headwater) habitats. The most common methodologies used in Colorado are the R2Cross method (Nehring 1979) and Instream Flow Incremental Methodology (IFIM) (Bovee 1982). IFIM estimates the amount of usable habitat for fish as a function of discharge by combining habitat suitability curves with the hydraulic model. The habitat component of the model has received much criticism because of assumptions implicit with using suitability curves and assumptions of positive relationships between habitat availability and fish abundance. Validation of these assumptions have been obstacles for successfully using IFIM to model minimum flow impacts on large warm water rivers of the west slope (Rose and Hahn 1989).

Currently there is no standardized approach to establish minimum flow needs on warm water river sections, and the use of sophisticated models appear to be required in high profile situations (Espegren 1998). Warm water fish assemblages appear to require a more intensive approach to instream flow modeling compared to cold water fish communities. Warm water river reaches tend to be lower gradient and have higher channel complexity and sediment loads. Warm water fish populations tend to have higher species diversity. Also habitat suitability curves derived from microhabitat observations do not adequately describe habitat use for many warm water species. A broader community-level perspective, as opposed to an indicator species approach, may be required to protect all habitats of a functioning warm water stream ecosystem.

Instream flow techniques require integration of two processes that combine detailed knowledge of habitat requirements (by species and life stage), and the availability of necessary

habitats. Both the collection and analysis of these data bases have been very labor intensive. Recent advances in surveying technique (e.g. G.P.S.) and computer capabilities (G.I.S.) allow for collection and processing of much larger databases. Also, two-dimensional (2-D) flow models may have potential for application in instream flow studies (Leclerc et al., 1995; Bovee, 1996). In theory, 2-D models offer a significant improvement over one-dimensional (1-D) modeling by increasing spatial resolution, allowing for highly accurate quantification of physical habitat availability. A spatially explicit flow model may eliminate the need for microhabitat suitability curves used by IFIM, and also improve biological resolution of the method. Presently, however 2-D modeling is not widely used for fishery applications and is still an unknown commodity as far as its practicality for instream flow assessment.

The original intent of this study was to develop and validate a methodology for determining instream flow recommendations for warm water fish communities in Colorado (Anderson 1999). This is to be accomplished by determining relationships between habitat availability and flow using a 2-D flow model to simulate meso-habitat diversity and abundance over a range of low flows on several sections of three different rivers. Also fish population and species' life history data will be collected within each of the study sites to provide habitat use and preference data to determine relationships between base flows and habitat availability for native fish species of warm water riverine fish communities.

A new study goal was added in 1999 to submit instream flow recommendations for the Yampa River and Colorado River in the 15-Mile Reach to the Colorado Water Conservation Board (CWCB), with biological justifications for a water right filings in those rivers, by August 2002. The CWCB withdrew water rights filings made in 1995 for these rivers. The 1995 filings were based on recommendations made by the U. S. Fish and Wildlife Service (USFWS) in regard to recovery of endangered fish species [Modde and Smith (1995) and Osmundson et al. (1995)]. In a more recent study Modde et al. (1999) used an inflection point method to assess minimum stream flow needs for Colorado pikeminnow (*Ptychocheilus lucius*) on the Yampa River. Even though the intent of these studies was the same, to determine stream flow requirements for endangered fish, the methods in each study were different. The CWCB expressed a desire to have a more standardized approach for instream flow filings and it is hoped that recommendations using this approach will be acceptable to agencies involved with endangered species recovery.

Study Objectives:

1). Model fish habitat availability on warm water sections of three rivers (Yampa, Colorado and Dolores) using the established methods (1-D models) and evaluate the practicality of using 2-D flow models to quantify fish habitat.

2). Determine community structure, density and biomass for fish assemblages for river reaches listed above.

3). Test for relationships between habitat availability and fish abundance.

4). Develop and validate methodologies that use 1-D and 2-D flow models for the Division of Wildlife to use for minimum instream flow recommendations for the warm water sections of the Yampa and Colorado Rivers.

SUMMARY AND CONCLUSIONS

Large differences were found in species composition between the two Yampa sites and the 15-Mile Reach. The 15-Mile Reach had the highest percent of native fish followed by the Sevens and Duffy had a very low percent of native fish.

Fish sampling has produced density estimates in the study area and indicate the carrying capacity of the river sections. This sampling effort does not indicate how fish shift in habitat use as flows change. However it is believed that density estimates are a higher priority for justifying instream flow recommendations.

Fish density and biomass on the 15-Mile Reach was much greater than in the Yampa River.

Preliminary modeling results show large differences in habitat composition between the Duffy site and the 15-Mile Reach. But statistical tests have not been completed.

Significant differences in density and biomass between the three study sites could be related to differences in habitat composition.

The 2-D modeling contract was vital for establishing data sampling protocols. The RTK GPS and echo sounder system proved very effective for surveying large sections of river. The project is now adequately equipped to survey river sections.

The 2-D flow modeling clearly produces excellent habitat mapping results and is absolutely necessary for this project to develop instream flow recommendation for the Yampa and Colorado Rivers. The 2-D modeling is still problematic mainly because of the large amount of

time required to calibrate and run the model for a set of desired flows. It is not likely that the modeling efficiency will improve without significant upgrades to the RMA2 software.

Without a new contract for 2-D modeling, sampling sites and fish sampling will be reduced to give more time to the researcher for modeling and reporting.

Additional information on the performance and practicality of the 2-D model will be included in the M.S. thesis by Greg Stewart.

RECOMMENDATIONS and ADJUSTMENTS TO STUDY DESIGN

1. In the 2000 field season, efforts will be made to sample a section of the Dolores River, the Lily Park reach on the Yampa River and a new site on the Colorado River. Spring runoff is very low in 2000 and could hamper field surveying because of low flows.

2. At the time of this report there is no contract set up for 2-D modeling. Efforts to get a graduate project to replace Greg Stewart have been unsuccessful so far. Efforts will be made to contract with a private consultant or with Utah State University. The Water Research Laboratory in Logan has a graduate program that uses and tests 2-D and 3-D flow models. This department has a full time staff capable of adapting the model to specific projects.